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(54) **Equipment for measuring the thickness and the compressibility of paper**

(57) Known equipments for measuring the thickness and compressibility of paper are awkward to use and the test results obtained with them are not immediately available for use. Additionally, for the measurement of these characteristics, separate equipment is needed. The equipment according to the invention includes a frame (1), a base (2) mounted on the frame, a compressing element (3) that can be moved in relation to the base, a measuring beam (4) mounted to the compressing element and a measuring head (5) detachably mounted to the measuring beam.

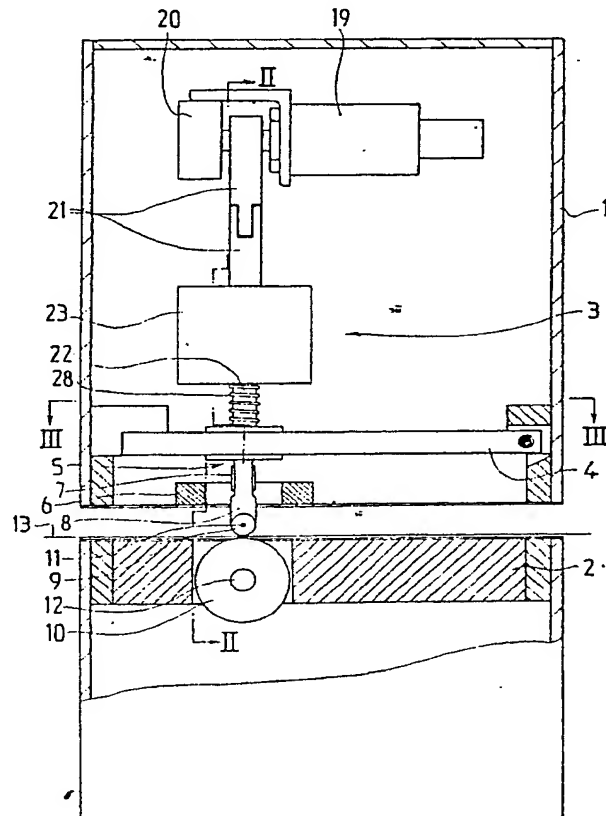


Fig. 1

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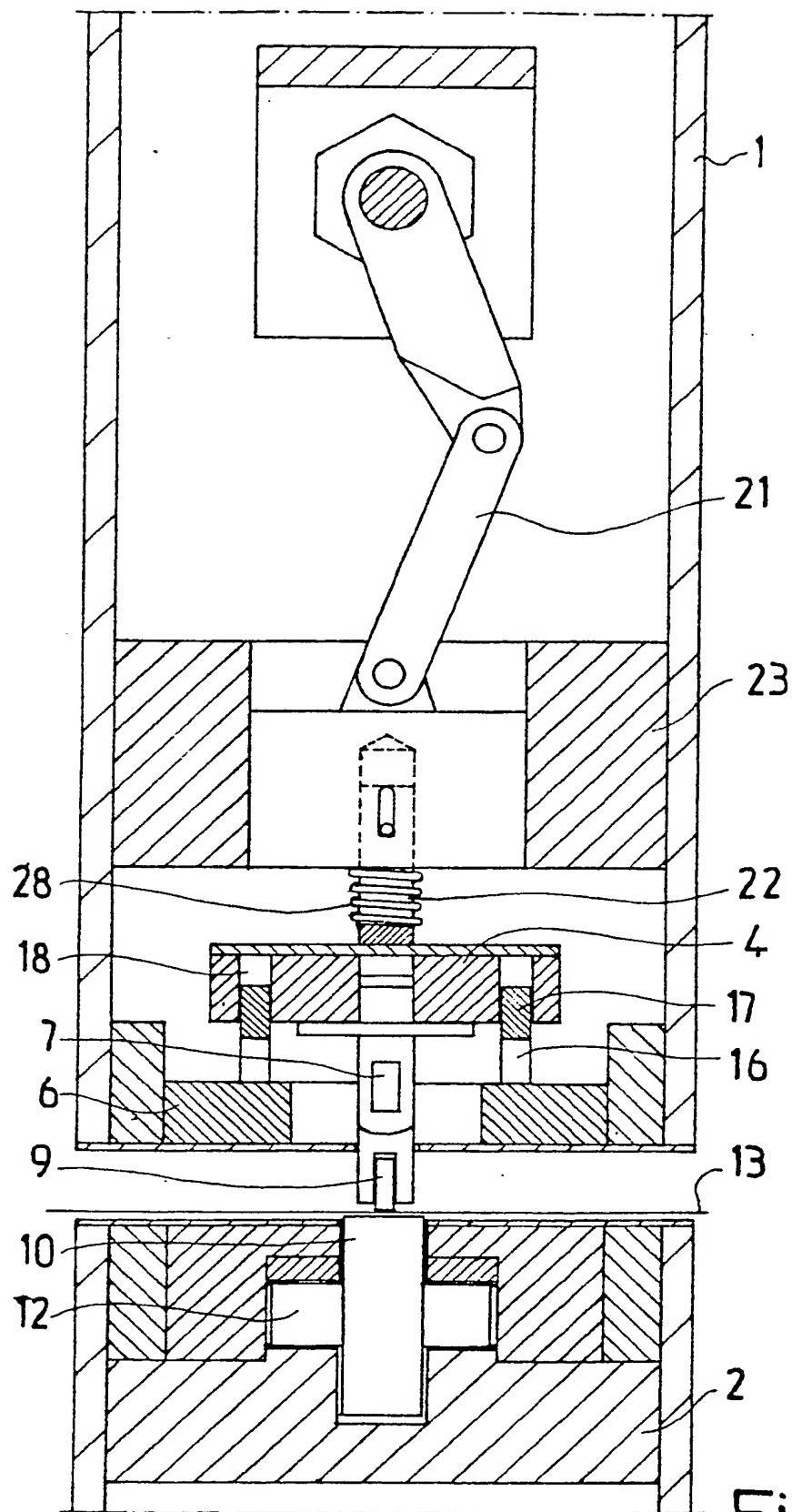


Fig. 2



## SPECIFICATION

**Equipment for measuring the thickness and the compressibility of paper**

The subject matter of the invention is equipment for measuring the thickness and the compressibility of paper.

Nowadays the thickness of paper is measured by measuring the distance of both surfaces of the paper by using micrometers or corresponding devices which are complicated and awkward to use. The compressibility of the paper is measured by compressing the paper and by measuring the compressive force and the compression distance with a measuring device connected to the compressing equipment. There are however drawbacks associated with the current equipment for measuring these characteristics.

The paper sample must be handled and moved before the measurements and thus the characteristics of the paper can change before its measurement. The execution of measurement is slow, because the measuring of the paper sample is carried out at one place at a time. Thus the results of testing cannot be obtained for immediate use. In addition to this, the results of measurement depend on the ability and skill of the person to handle the paper and the measuring equipment and to read the measurement results. In addition to this, separate equipment is needed for measuring the thickness and the compressibility of the paper.

An object of the invention is to bring out equipment for measuring the thickness and compressibility of paper, which in measuring these characteristics reduces the drawbacks of previously known equipment. A further object of the invention is to bring out equipment with which the thickness of the paper sample can be continuously and accurately measured and with which the compressibility of the paper can also be accurately measured. Additionally an object of the invention is to bring out equipment which is easy to use and easy to move without deterioration of measuring accuracy.

An object of the invention is also to bring out equipment with which device both the thickness of the paper and its compressibility can be measured.

The object of the invention is achieved with equipment which is, in its main characteristics, that set out in the annexed claims.

The equipment according to the invention includes a frame, a base connected to the frame and a measuring head which is detachably mounted onto a measuring beam and it is arranged to move relative to the base. The equipment in addition includes measuring devices for the measurement of the movement of the measuring head and of the compressive force. Precise determination of the movement of the measuring head in relation to the base and also of the compressive force against the base, throughout the test period, is obtained with the equipment according to the invention. The equipment is easy to use and the results can be immediately brought into use with the aid of known output devices. In carrying out the meas-

urements the paper sample is brought in between the base and measuring head with the individual conveying device of the distribution equipment or with other known methods. The equipment can also form a part of the testing equipment measuring different characteristics of the paper, when the conveyor of the equipment is arranged to move the paper sample into the equipment and in the equipment. The equipment can also be a separate testing device and it can easily be moved and used in the immediate vicinity of the manufacturing or application process when the testing results immediately become known.

In the following the invention is described in more detail by referring to the accompanying drawings in which:

*Figure 1* presents one special application of the equipment according to the invention as seen from the side and in partial cross-section.

*Figure 2* presents the cross-section through II-II of the equipment according to *Figure 1*.

*Figure 3* presents the cross-section through III-III of *Figure 1*, and

*Figure 4* presents a measuring head according to the invention, for measuring compressibility.

The equipment of the applications according to the invention and presented in *Figures 1 - 3* consists of frame 1, base 2 connected to the frame and a compressing element 3, which can be moved relative to the base. The compressing element is arranged to be moved with the aid of the motor 19, the driving devices 20 connected to it and the jointed arms 21. The compressing element consists of a bar 22 and the guide block 23, which is fastened to the frame and is arranged to control the movement of the bar.

The equipment also consists of a measuring beam 4, fastened to the bar, onto which measuring beam the measuring head 5 is detachably mounted. In the application presented in the illustration the measuring beam is fastened at both ends by bearings to the frame. According to *Figure 3* one end 24 of the measuring beam is fastened to the frame with the aid of the bearing pin 25 and the other end of the measuring beam 26 is fastened to the frame with the aid of the end bearing 27. Thus both ends of the measuring beam are in this application movably mounted to the frame. The measuring beam can in some other application be mounted to the frame at one end only by bearings.

According to the *Figures 2 and 3* the equipment consists of two bearing pins 15 arranged in the vicinity of the measuring head and which are fixed to the frame at one end 16 and the other ends of which 17, are arranged to move freely in the drilled holes 18 made in the measuring beam. These two pins are arranged on opposite sides of the measuring head in the neighbourhood of the longitudinal side of the measuring beam and they perpendicularly guide the movements of the measuring beam relative to the base. The measuring equipment in application here presented also consists of a measuring device 6 in order to measure the movement of the measuring head in relation to the base. In

the applications presented in the Figures the measuring device is arranged to measure the movements of the measuring beam, when information concerning the movements of the measuring head 5 connected to the measuring beam is simultaneously obtained. Known equipment suitable for this purpose such as, for example, capacitors, can be used as measuring devices.

The equipment according to the invention consists of different kinds of measuring heads and equipment corresponding to them and fastened to the base for measuring the different characteristics of paper. A measuring head 5 is detachably mounted to the measuring beam 4 of the equipment presented in Figures 1 and 2, to which belongs the arm 8 and the measuring wheel 9, rotatably mounted to the end of the arm. The counterpressure wheel 10 is correspondingly detachably mounted to the base. The wheels are mounted so that the axes 11, 12 of the wheels are parallel in arrangement within distance of each other and the measuring wheel is arranged to be moved in rotation to the counterpressure wheel and to be pressed against the counterpressure wheel. Additionally the equipment includes measuring heads 7 for measurement of the compressive force between the measuring wheel and the counterpressure wheel.

The thickness of the paper is measured by the equipment according to Figures 1 and 3 by bringing the sample of the paper 13 in between the measuring wheel and the counterpressure wheel, by setting the compressing element into motion towards the base, whereupon the measuring head 35 moves towards the counterpressure wheel. The measuring wheel is compressed against the counterpressure wheel with a known compressing force and the sample of paper 13 is caused to move between the wheels. In moving the sample of paper 40 between the counterpressure wheel and the measuring wheel while the counterpressure wheel is fastened to the base, the thickness of the paper and the changes in it can be measured by measuring the movement of the arm of the measuring wheel in relation to the counterpressure wheel and the base. The equipment additionally includes a spring element 28 arranged between the guide 23 and the measuring beam in order to damp the movement of the measuring beam.

The equipment according to the invention also includes the measuring head presented in Figure 4, the head of which is detachably fastened to the measuring beam. The measuring head presented in this figure also includes the arm 8b and the plate measuring element 14, fastened to the end of the arm. The plate-like measuring element is used in measuring the compressibility of the paper and then a plate is detachably mounted to the base of the equipment, in relation to which the measuring element is arranged for movement in the perpendicular direction with the aid of the compressing element and the measuring beam.

The measuring element is arranged to be compressed against the plate in order to measure the compressibility of the sample of the paper brought

between the measuring element and the plate by measuring the compressive force with the aid of the measuring device 7 mounted to the arm 8b and by measuring the movement of the measuring head with the aid of the measuring device 6 mounted to the frame.

The invention has been heretofore explained by referring to one advantageous example of application, but also other applications and variations are possible whilst keeping within the boundaries of the concept of the invention defined by the patent claim.

## CLAIMS

1. Equipment for measuring the thickness and compressibility of paper, characterised in that the device includes a frame, a base connected to the frame, a compressing element movable in relation to the base, a measuring beam fastened to the compressing element, a measuring head detachably mounted to the measuring beam, and measuring devices for the measurement of the movement of the measuring head and the compressive force in relation to the base.

2. An equipment according to claim 1, characterised in that the measuring head includes an arm and a measuring wheel rotatably mounted to the end of the arm, and that a rotatable counterpressure wheel is detachably mounted to the base so that the wheel axes are arranged in parallel and the measuring wheel is arranged to be moved in relation to the counterpressure wheel and to be compressed against the counterpressure wheel, whereupon a sample of paper brought between the counterpressure wheel and the measuring wheel is arranged to be moved in relation to the wheels and the measuring device is arranged to measure the movement of the arm in relation to the counterpressure wheel in moving the sample of the paper.

3. An equipment according to the claim 1, characterised in that the measuring head includes an arm and a plate-like measuring element mounted to the end of the arm, and that there is a plate detachably mounted to the base against which the measuring element is arranged to be compressed in order to measure the compressibility of the paper sample brought between the measuring element and the plate.

4. An equipment according to any one of the claims 1-3, characterised in that the measuring beam is, at least at one end, mounted in bearings to the frame.

5. An equipment according to claim 4, characterised in that the equipment comprises at least two bearing pins arranged in the vicinity of the measuring head and which are at one end fastened to the frame, and at the other end of which arranged to move within drillings made into the measuring beam.

6. An equipment according to any of the claims 1-5, characterised in that the measuring device is arranged to measure the movement of the measuring beam in relation to the base.

7. An equipment according to any of the claims 1-5, characterised in that the measuring equipment for the measurement of the compressive force is fastened to the arm of the measuring head.

- 5 8. Equipment according to claim 1 substantially as herein described with reference to and as shown in Figures 1-3 or Figure 4 of the accompanying drawings.

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